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1.—The Physiography, Vegetation and Vertebrate Fauna of the Wallabi Group, Houtman Abrolhos

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The physiography and vegetation are described. All known vascular plants are listed (including those from North Island). Brief accounts are given of the reptiles, land-birds and mammals. The biogeography of the islands is discussed.

Introduction

In order to procure live wallabies (*Macropus eugenii*) for experiments and to observe them in the field, the Zoology Department organised three short trips to the Wallabi Islands in 1959 (April 16-22, June 21-25 and September 2-12) and one in 1960 (April 22-27). The writer had the good fortune of taking part in all of them and was able to make extensive collections of vascular plants and vertebrate animals.

The physiography of the Wallabi Group has been described by Dakin (1919) and still more fully by Teichert (1947). The following account is therefore brief—just enough for describing plant habitats and for a later discussion of the biogeography of the islands. The vegetation will be dealt with at greater length, for scarcely anything was previously known of it. In the accounts of the fauna, the writer has drawn freely on the observations of the naturalists who preceded him in these islands.

Physiography

The Houtman Abrolhos lie about 40 miles off the west coast of Western Australia between latitudes 28 and 29. The sea-bed west of the mainland descends in the first 5-10 miles to a depth of 20 fathoms, but one must go a further 40-45 miles before reaching the 40-fathom line, westwards from which the sea-bed dips steeply to the edge of the continental shelf. The Abrolhos are thus situated towards the western margin of a gently sloping platform. Each of the island clusters (Wallabi, Easter and Pelsart Groups) is located on a plateau-like hump on this platform. Although soundings are limited, it seems that North Island rises from the same submarine plateau as the Wallabi Group.

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East and West Wallabi, with areas of 900 and 1,500 acres and dunes up to 50 feet high, are by far the largest and highest of the Abrolhos Islands. They and their nearest neighbours emerge from a broad rock-flat, composed mainly of old coral reefs which were planed in an earlier cycle of erosion to a level of 1-2 feet above present sea-level. Subsequent erosion has lowered much of the flat, though considerable areas in the lee of West Wallabi still lie above low water.

On much of West Wallabi and almost all of East Wallabi the old reefs are overlain by beds of younger limestone, 3-10 feet thick. Their composition varies: in some areas, shells or coral fragments predominate; in others, there is little or no macroscopic structure. But whatever their composition, the beds are remarkably uniform in appearance at the surface. Everywhere the fairly level exposures are cracked, so that the resultant slabs form, as it were, a gigantic crazy pavement. There is sufficient soil between the slabs to support a moderately varied assemblage of shrubs. Subterranean caverns are common, and several sink-holes have been enlarged or cleaned out to form wells that provide a modest supply of fresh water.

This pavement limestone occupies a large unbroken portion of the western half of East Wallabi. Its occurrence on West Wallabi is discontinuous. The largest area is in the central south of the island, extending from low cliffs in Rocky Bay to the inner foot of the west coast dunes. The next largest occurrence is on the ridge immediately inland from the north-east coast between Blowfish and Slaughter Points. Towards the northern end of this ridge the beds attain their highest elevation (c.10 feet). All the islets in the vicinity of the two main islands (Pigeon, Little Pigeon, Seagull, Tattler, Pelican, etc.) are composed entirely of this limestone. Uniformly about six feet high and surrounded by vertical or undercut cliffs, they are confusingly similar in appearance. In contrast, the low islets at the eastern margin of the Wallabi Group (Beacon, Long, Dick's, etc.) consist largely of coral boulders and

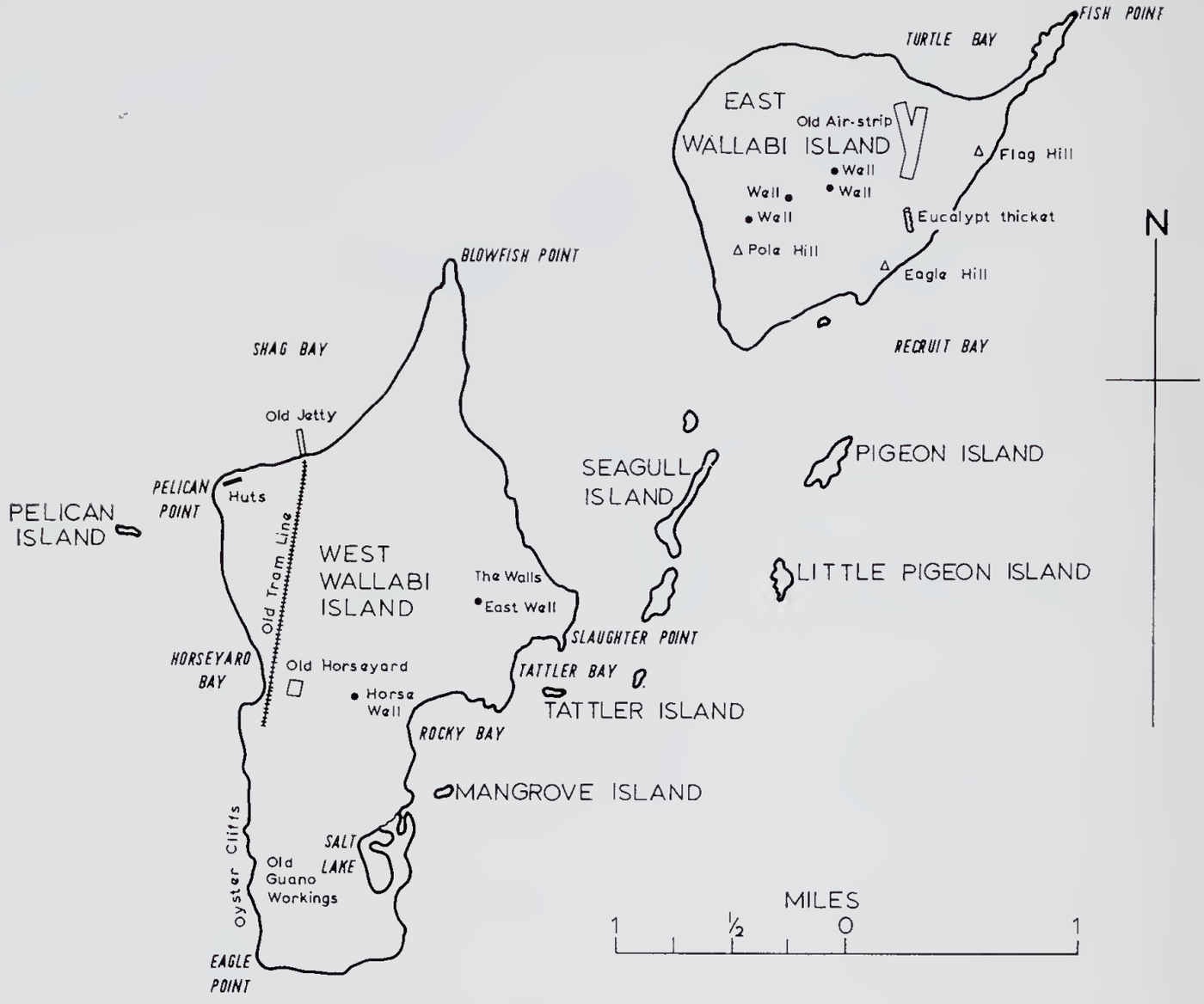

Fig. 1.—Wallabi Islands, Houtman Abrolhos, Western Australia.

shingle, much of it too recently thrown up from neighbouring lagoons to have become consolidated.

The only considerable part of the islands in which the old reef flat is not overlain by pavement limestone is the northern end of West Wallabi, west of the limestone ridge. Low-lying areas (less than two feet above sea-level), where the reef flat may appear at the surface, carry sheets of water after winter rains. Elsewhere the flat is covered with up to five feet of shell grit, interrupted here and there by narrow banks of guano-rich soil, usually striking N.E.-S.W. Evidently the whole of this area was a part of Shag Bay when sea-level was slightly higher than now. There is another and smaller break in the pavement limestone at the salt-lake, a little inland from the south-east coast of West Wallabi. At high tide the lake is connected with the sea by a small creek.

On East and West Wallabi (and North Island), alone of the Abrolhos, the pavement limestone may be overlain by dunes. Along the north and west coasts of East Wallabi and the central west coast of West Wallabi the dunes of calcareous sand are unconsolidated, and in some places they are completely blown out. Between these dunes and the sea there are sandy beaches. In the eastern half of East Wallabi and the south-west corner of West Wallabi the dunes are consolidated, their orientation generally being N.N.W/S.S.E. and their bulk consisting of aeolianite, as can be seen in exposures at coastal cliffs. Where covered with sand the underlying presence of aeolianite is indicated by the greater density and variety of the vegetation compared to that on sandy dunes.

Vegetation

The dominant plant above beaches is the coarse tussocky grass, *Spinifex longifolius*. Other species are scarce and are represented by scattered individuals or an occasional stand of *Atriplex cinerea, Salsola kali, Senecio lautus* and *Poa caespitosa*. Shrubs are more common in the sandy dunes, e.g., *Olearia axillaris, Acanthocarpus preissi* and occasionally *Myoporum insulare;* but much of the ground is bare.

Seeing that the distinction between sand and shell grit is merely one of particle size, the vegetation of the two are surprisingly different. The plant cover is much more continuous on

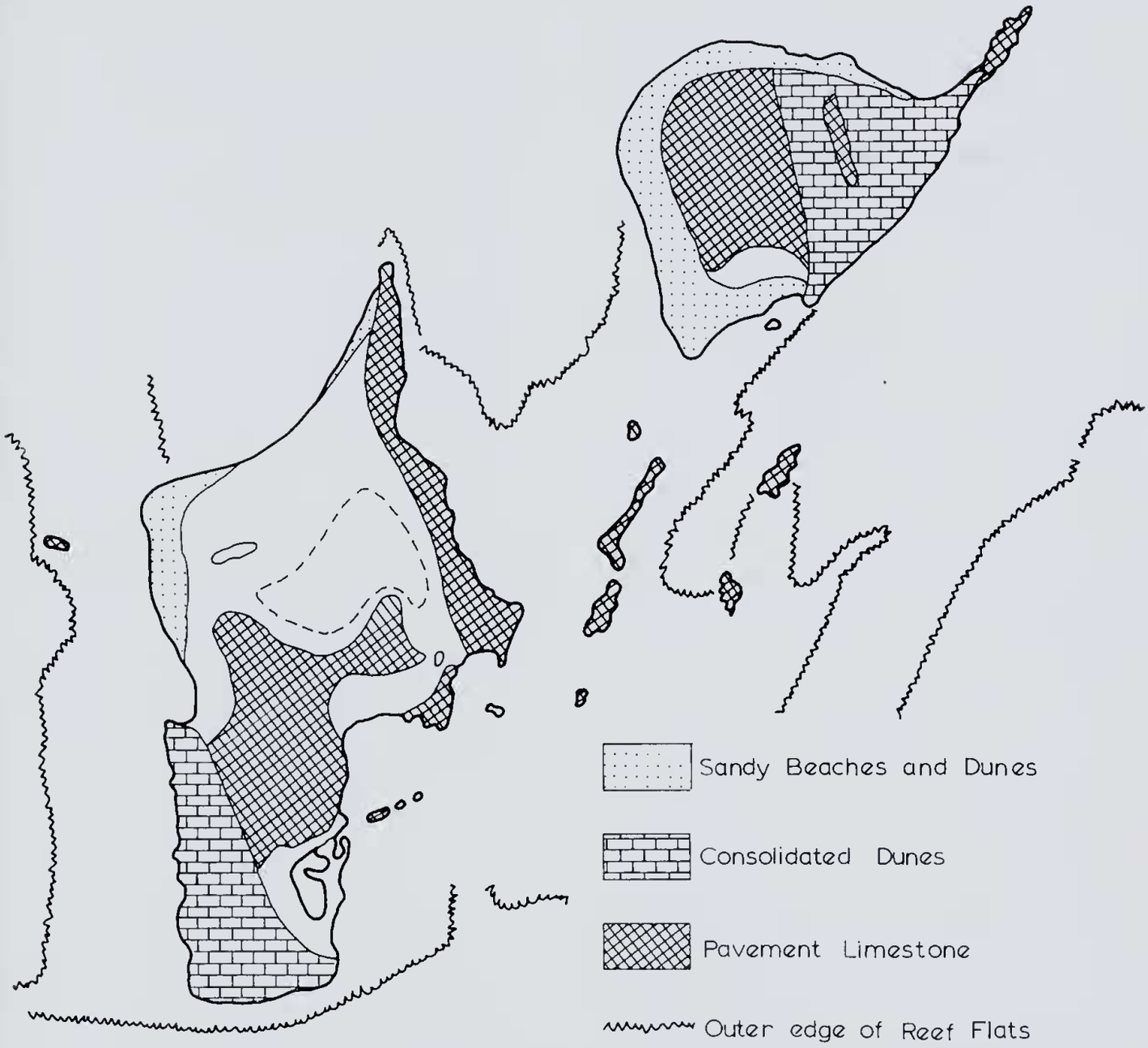

Fig. 2.—Wallabi Islands, showing physiographic divisions. The unshaded areas mainly consist of shell grit. The broken line in the middle of West Wallabi encloses land less than two feet above sea-level; it is an old rock-flat with little or no covering of shell grit; to its west is a small ridge of pavement limestone that was inadvertently left unhatched on this map.

the shell grit. A low saltbush is dominant, *Atriplex paludosa*, which tends to be replaced in low-lying areas by the shrubby samphire, *Arthrocnemum halocnemoides*. Other species include *Threlkeldia diffusa*, *Senecio lautus*, *Frankenia pauciflora* and stunted shrubs of *Olearia axillaris*. The whole of this country on West Wallabi is riddled with the burrows of mutton-birds *(Puffinus pacificus)*. On East Wallabi, where beds of shell grit are much less extensive, the saltbush and samphire is replaced by thickets of *Diplolaena dampieri* and *Alyxia buxifolia*. In the narrow ecotone between the shell grit and pavement limestone the vegetation becomes sparse and virtually restricted to *Frankenia*.

Despite the scarcity of soil, the pavement limestone supports a fairly rich vegetation. The dominant species are shrubs from 3-8 feet tall: *Pittosporum phillyreoides*, *Diplolaena dampieri*, *Grevillea argyrodendron* *Spyridium globulosum*, *Exocarpus aphylla*, *Capparis spinosa*, *Pimelea microcephala*, *Sarcostemma australe*, *Olearia axillaris* and *Beyeria viscosa*. Also commonly present are *Dianella revoluta*, *Acanthocarpus preissii* and *Hibbertia subvaginata*.

All plants of the pavement limestone may be found on consolidated dunes; and on East Wallabi, where the aeolianite is usually close to the surface, several additional shrubs appear: *Dodonaea inacquifolia*, *Trichinium divaricatum*, *Lasiopetalum angustifolium*, *Leucopogon insularis*, *Acacia bivenosa*, *Mirbelia ramulosa* and *Bossiaea rufa*. In one valley there is a thicket of *Eucalyptus oraria*, about 6 chains long and 1-2 chains wide. Though their stems are up to six inches in diameter, they have been so bent over by the prevailing southerlies that the

tops of the trees are only 3-8 feet above the ground. Possibly some of the larger trees have been removed, for in 1843 Gilbert found a tree whose trunk was 18 inches through. Otherwise this thicket seems to be much as it was 120 years ago.

In contrast to East Wallabi, the flora of the consolidated dunes on West Wallabi is impoverished. Large areas are completely overrun by *Nitraria schoberi;* and the introduced succulent, *Cryophytum crystallinum*, monopolises otherwise bare ground.

Annual rainfall in the Abrolhos is probably about 12-15 inches, most of it falling from May to September. During my visit in April 1959, the condition of the vegetation was generally poor. The first substantial rain fell (in my absence) on May 29. Some showers were received on June 17, 2-3 inches on June 19, and a considerable amount on June 20 (the day before my second visit). By June 22 the vegetation had recovered: *Pimelea* was shooting profusely; *Carpobrotus* was clearly filling out; and *Diplolaena* had lost its grey half-dead appearance. Seedlings of annual species were abundant, but most of them were too young for identification. By early September the annuals had matured and were flowering. They were especially plentiful in mutton-bird rookeries and on offshore islets.

One of the anomalies of the vegetation of the islands is its greater richness on East Wallabi than on the considerably larger West Wallabi. The latter, though generally similar physiographically to East Wallabi, differs in certain other respects. First, West Wallabi has (or had) large deposits of guano. Second, it alone is colonised by burrowing petrels. Finally, but not so certainly, it has a denser population of wallabies.

It has already been mentioned that the consolidated dunes of West Wallabi are dominated by *Nitraria*, whereas those of East Wallabi support a good variety of shrubs and low trees, including several species unknown from West Wallabi. This difference can only be due to the ubiquitous presence of guano in the south-western dunes of West Wallabi. As Gillham (1963) has shown, few species of plants tolerate a high concentration of guano.

Extraction of the guano between 1884 and World War I involved the vegetation in large-scale disturbances. Before removing the guano, which mostly lodges among boulders of limestone, all plants were stripped from an area, the stones laid to one side, and the soil shovelled with hoes and swept with heavy brooms into heaps (Helms 1902). Apart from the remains of a jetty, tramline and horsеyard, and some obviously unnatural hollows and heaps of stones in the dunes, there was little evidence in 1959 of this once profitable industry. All the old excavations were completely revegetated but whether any plant species were permanently affected by this activity could not be ascertained. Likewise unknown is the effect of stock on the islands, e.g. the flock of goats formerly depastured on East Wallabi.

The presence of burrowing petrels on West Wallabi has had a twofold effect: (1) the suppression of sclerophyllous shrubs (with the partial exception of *Frankenia and Olearia*) and their replacement by halophytic shrubs: (2) the encouragement of coprophilous annuals such as *Urtica urens, Chenopodium murale, Stellaria media* etc. The dominance of saltbush and samphire on the beds of shell grit inland from Shag Bay seemed at first sight to be due to soil salinity. But on East Wallabi similar beds between the limestone pavement and the beach at the southern tip of the island were found to carry a scrub of *Diplolaena* and *Alyxia*. The conclusion was inescapable that the petrels, whose burrows occurred throughout the West Wallabi shell grit, were in some way responsible for the dominance of the halophytes.

Apart from their 'hedging' of shrubs (details of which are given later) it is not easy to discern the effect of wallabies on the vegetation. If one compares the vegetation of the Wallabi Islands with that of North Island (on which wallabies no longer occur), the only obvious differences are the greater abundance of *Myoporum* on North Island, and the greater height and density of the annuals, especially grasses and composites, several species of which have not yet been recorded from the Wallabi Islands. As for differences between the two Wallabi Islands, the only one that seems attributable to wallabies is the relative abundance of *Eremophila glabra* in the eastern dunes of East Wallabi, where the animals are apparently not plentiful. This highly palatable undershrub was found on West Wallabi only in a small area east of Horse Well. If a portion of the old air-strip on East Wallabi were fenced off, the effect of the numerous wallabies in that area would soon be revealed.

Annotated List of Plants

In a brief account of the vegetation of North Island (Storr 1960) only perennial plants were mentioned. The opportunity has been taken here to include all the species that were collected or observed on that island.

An asterisk before a specific name signifies that the plant has been introduced, and one after the name of an island signifies that the record is based on material identified by Mr. R. D. Royce. Many of the herbaceous species were only seen in winter and spring; though recorded herein as "annual", some of them could in fact be perennial in the strict sense of the word.

POTAMOGETONACEAE

Cymadocea antarctica (Labill.) Endl. and *Posidonia australis* Hook. f. Both these seaweeds were found cast up on the coast of West Wallabi*, and the first was also found on North I*.

SCHEUCHZERIACEAE

Triglochin mucronata R. Br. Small annual. North I.* (banks of salt-lake), West Wallabi* (damp flats).

T. trichophora Nees. Small annual. North I.*, East Wallabi*.

T. muelleri Buch. Small annual. East Wallabi*

GRAMINEAE

Setaria dielsii Herm. Annual. North I.*, West Wallabi*, Pigeon I.*.

Spinifex longifolius R. Br. Perennial. Coastal sand: North I.*, East Wallabi*, West Wallabi*.

**Phalaris minor* Retz. Annual. North I.* (near fishermen's camp), West Wallabi (mutton-bird rookeries).

Stipa elegantissima. Labill. Perennial. East Wallabi (consolidated dunes), West Wallabi*, Pigeon I.

S. variabilis Hughes. Perennial. North I., East Wallabi* (pavement), West Wallabi* (rare), Tattler I.

S. crinita Gaud. North I.*.

Sporobolus virginicus (L.) Kunth. Perennial. North I.* (damp soil south of salt-lake), West Wallabi* (shingly sea-sprayed beach on south coast).

Agrostis avenacea Gmel. East Wallabi*, West Wallabi*.

Polypogon monspeliensis (L.) Desf. Annual West Wallabi*.

P. tenellus R. Br. Annual. East Wallabi*, West Wallabi*.

**Avena fatua* L. Annual. North I.*.

Danthonia caespitosa Gaud. Perennial. North I.*, East Wallabi*.

**Koeleria phleoides* Pers. Annual. North I.*.

**Vulpia myuros* (L.) Gmel. Annual. North I.*, East Wallabi*, West Wallabi* (mutton-bird rookeries).

Eragrostis dielsii Pilger. North I.*.

Poa caespitosa Forst. Perennial. East Wallabi* (sand dunes).

**Bromus madritensis* L. Annual. North I.*.

B. arenarius. Labill. Annual. North I.*, East Wallabi* (pavement), West Wallabi* (north-east coast and mutton-bird rookeries).

**B. molliformis* Lloyd. Annual. North I.*.

**Cynodon dactylon* Rich. Perennial. North I.*, (around fishermen's huts).

**Hordeum leporinum* Link. Annual. North I.*.

CYPERACEAE

Scirpus antarcticus L. Small annual. East Wallabi*, West Wallabi*.

JUNCACEAE

Juncus bufonius L. Small annual. North I.*, East Wallabi (stony gully in eastern dunes).

LILIACEAE

Anguillaria dioica R. Br. Annual. North I.*, East Wallabi*, West Wallabi*.

Bulbine semibarbata (R. Br.) Haw. Annual. North I.* (shallow soil over limestone), East Wallabi* (consolidated dune), West Wallabi* (pavement and shell grit).

Thysanotus patersoni R. Br. Perennial twiner. North I.*, East Wallabi*, West Wallabi* (pavement), Pigeon I.

Dianella revoluta R. Br. Perennial. East Wallabi* (consolidated dune), West Wallabi and Pigeon I. (pavement).

Acanthocarpus preissii Lehm. Low sprawling shrub. Pavement, consolidated dune, shallow sand over limestone; North I.*, East Wallabi, West Wallabi, Pigeon I.

ORCHIDACEAE

Microtis unifolia (Forst.) Reichb. Annual. East Waliabi* (pavement).

URTICACEAE

**Urtica urens* L. Annual. West Wallabi* (mutton-bird rookeries).

Parietaria debilis G. Forst. Small annual. North I.*, East Wallabi* (consolidated dunes), West Wallabi* (mutton-bird rookeries).

PROTEACEAE

Grevillea argyrophylla Meissn. Shrub. East Wallabi* (consolidated dunes), West Wallabi* and Pigeon I. (pavement).

SANTALACEAE

Exocarpus spartea R. Br. Shrub. North I.* (sand dunes).

E. aphylla R. Br. Shrub. East Wallabi* (consolidated dunes), West Wallabi* and Tattler I. (pavement).

CHENOPODIACEAE

Rhagodia baccata (Labill.) Moq. Succulent shrub. Shell grit, consolidated dunes, pavement: North I.*, East Wallabi*, West Wallabi*, Tattler I., Pigeon I.

Chenopodium nitrariaceum (F. v. M.) Benth. Low succulent shrub. East Wallabi*.

Ch. carinatum R. Br. Annual. East Wallabi* (gull rookery at Fish Point).

**Ch. murale* L. Annual. North I.* (? sp.), West Wallabi* (mutton-bird rookeries and guano), Pelican I.

Ch. plantaginellum (F. v. M.) Aellen. Annual. East Wallabi* (gull rookery at Fish Point).

Atriplex paludosa R. Br. Low succulent shrub. Abundant on shell beds, shell grit, shingles: North I.*, West Wallabi*, Pelican I., Mangrove I., Tattler I., Pigeon I., Long I.

A. cinerea Poir. Low succulent shrub. North I.* and East Wallabi (fore-dune).

Enchylaena tomentosa R. Br. Low succulent shrub. North I.*, Pelican I., Mangrove I., Pigeon I.

Threlkeldia diffusa R. Br. Small ascending succulent shrub. Coastal sand, shingles and rock, and inland on shell grit: North I.*, East Wallabi*, West Wallabi*, Tattler I., Pigeon I.

Arthrocnemum arbuscula R. Br. Succulent shrub. North I.* (muddy floor of sink-hole, and banks of salt-lake), East Wallabi (coastal shell beds), West Wallabi* (shell grit and especially banks of guano), Pigeon I.

A. halocnemoides Nees. Succulent shrub. Shallow shell grit over limestone: North I.*, East Wallabi, West Wallabi*.

Salicornia australis Banks & Sol. Small flaccid succulent shrub. North I.* (damp mud in sink-hole, and low-lying flat south of salt-lake), West Wallabi (edge of tidal creek), Tattler I. (beneath mangroves).

Suaeda australis (R. Br.) Moq. Small flaccid succulent shrub. North I.* (with *Salicornia* and *Sporobolus* in damp soil south of salt-lake), Tattler I. (beneath mangroves).

Salsola kali L. Annual. North I.* (leeward slopes of east dunes), West Wallabi (beach).

AMARANTHACEAE

Trichinium obovatum Gaud. Small shrub. East Wallabi* (pavement).

T. divaricatum Gaud. Shrub. East Wallabi* (consolidated dunes).

T. eriotrichum (W. V. Fitzg.) C. A. Gardn. Climbing shrub. East Wallabi* (consolidated dunes), West Wallabi* (pavement).

Ptilotus villosiflorus F. v. M. Annual. West Wallabi*.

AIZOACEAE

**Cryophytum crystallinum* (L.) N. E. Br. Prostrate succulent annual. North I.* (banks of salt-lake), West Wallabi (guano workings), Pelican I. (abundant), Tattler I., Pigeon I.

Carpobrotus aequilaterus (Haw.) N. E. Br. Prostrate succulent perennial. North I.*, East Wallabi (consolidated dunes), West Wallabi (pavement, especially near coast), Tattler I, Pigeon I. White flowers as well as red on North and Tattler Islands.

PORTULACACEAE

Calandrinia calyptrata Hook. f. Small succulent annual. North I.*.

CARYOPHYLLACEAE

**Stellaria media* (L.) Vill. Small annual. West Wallabi* (mutton-bird rookeries).

**Sagina apetala* L. Small annual. East Wallabi*.

**Spergularia rubra* (L.) J. & C. Presl. Small annual. North I.*, East Wallabi*, West Wallabi*, Pigeon I.

RANUNCULACEAE

Ranunculus parviflorus L. Small annual. East Wallabi*.

CAPPARIDACEAE

Capparis spinosa L. Trailing shrub. Pavement and consolidated dune: East Wallabi*, West Wallabi*, Tattler I., Pigeon I.

CRUCIFERAE

Hymenolobus procumbens (L.) Nuttall. Small annual. North I.*, East Wallabi*, West Wallabi*.

Cakile maritima Scop. Annual. North I.* (beaches and blown-out dunes), East Wallabi.

CRASSULACEAE

Crassula colorata (Nees) Ostenf. Small annual. North I.*, East Wallabi* (sand dunes), West Wallabi*.

PITTOSPORACEAE

Pittosporum phillyreoides DC. Tall shrub. Pavement and consolidated dunes: East Wallabi*, West Wallabi*, Tattler I., Pigeon I.

CUNONIACEAE

Aphanopetalum clematideum (Drumm. & Harv.) C. A. Gardn. Shrub. East Wallabi*.

LEGUMINOSAE

Acacia bivenosa DC. Shrub. East Wallabi* (consolidated dunes).

Mirbelia ramulosa (Benth.) C. A. Gardn. Shrub. East Wallabi* (consolidated dunes).

Bossiaea rufa R. Br. *var. foliosa* Benth. Shrub. East Wallabi* (consolidated dunes).

GERANIACEAE

Erodium cygnorum Nees. Annual. North I.*, East Wallabi*, Pigeon I. (? sp.).

**E. cicutarium* (L.) L'Her. Annual. East Wallabi* (consolidated dunes), West Wallabi* (mutton-bird rookeries).

Pelargonium littorale Hugel. East Wallabi*.

OXALIDACEAE

Oxalis corniculata L. Small annual. East Wallabi* (consolidated dunes), West Wallabi*.

ZYGOPHYLLACEAE

Zygophyllum apiculatum F. v M. Small annual. North I.*, East Wallabi*, West Wallabi*.

Nitraria schoberi L. Succulent shrub, sometimes tall. Coastal: North I.*, East Wallabi, West Wallabi, Pelican I., Mangrove I., Tattler I., Pigeon I., Long I., Beacon I.

RUTACEAE

Diplolaena dampieri Desf. Shrub. East Wallabi* (pavement, consolidated dunes, shell grit), West Wallabi* and Pigeon I. (pavement).

EUPHORBIACEAE

Phyllanthus calycinus Labill. Small shrub. East Wallabi* (consolidated dunes), West Wallabi.

Euphorbia drummondii Boiss. Small annual. East Wallabi*.

E. clutioides (Forst.) C. A. Gardn. Annual. North I.* (inner slope of western dunes).

Beyeria viscosa (Labill.) Miq. Shrub. East Wallabi* (pavement and consolidated dunes), West Wallabi* (pavement).

STACKHOUSIACEAE

Stackhousia viminea Sm. Perennial herb. North I.*, East Wallabi*, West Wallabi*.

SAPINDACEAE

Dodonaea aptera Miq. Shrub. North I.*, East Wallabi* (consolidated dunes and pavement), West Wallabi* (pavement).

D. inaequifolia Turcz. Shrub. East Wallabi* and West Wallabi* (pavement).

RHAMNACEAE

Spyridium globulosum (Labill.) Benth. Shrub, sometimes tall. Shallow sand over limestone, consolidated dunes and pavement: North I.*, East Wallabi, West Wallabi*.

MALVACEAE

Lavatera plebeja Sims. Tall perennial herb. Pelican I. (single plant).

**Malva parviflora* L. Annual. North I., East Wallabi*, Pigeon I.*.

STERCULIACEAE

Lasiopetalum angustifolium W. V. Fitzg. Shrub. East Wallabi* (consolidated dunes).

DILLENIACEAE

Hibbertia subvaginata Steud. Small shrub. East Wallabi*, West Wallabi* (pavement).

FRANKENIACEAE

Frankenia pauciflora DC. Small shrub. North I.* (shallow soil over limestone, especially at inner foot of western dunes), East Wallabi* (consolidated dunes), West Wallabi* (stony country near coast and shell grit, especially where it contacts pavement), Tattler I., Pigeon I.

THYMELAEACEAE

Pimelea microcephala R. Br. Shrub. North I.* (shallow sand over limestone; rare), East Wallabi* (consolidated dunes), West Wallabi* (pavement), Tattler I., Pigeon I.

MYRTACEAE

Eucalyptus oraria L. A. S. Johnson. Small tree. East Wallabi* (consolidated dunes). Restricted to a single valley in the eastern dunes between Flag and Eagle Hills. A specimen collected by Dr. D. L. Serventy in 1945 was identified by Mr. C. A. Gardner (1949) as *E. gracilis*, a species otherwise known only from the semi-arid woodlands of the southern interior of the State. In *E. gracilis* the bark is deciduous, whereas all but the smallest branches of the East Wallabi trees are covered with rough grey bark. The trees were beginning to flower on April 20, 1959.

HALORAGACEAE

Haloragis trigonocarpa F. v. M. Perennial herb. East Wallabi*.

UMBELLIFERAE

Didiscus pilosus Benth. Annual. East Wallabi*.

Hydrocotyle diantha DC. Small annual. East Wallabi* (stony gully in eastern dunes), West Wallabi*.

Apium australe Pet.-Thou. Small annual. East Wallabi* (consolidated dunes), West Wallabi* (mutton-bird rookeries).

Daucus glochidiatus (Labill.) Fisch., Mey. & Ave-Lall. Small annual. North*, East Wallabi* (consolidated dunes), West Wallabi*.

EPACRIDACEAE

Leucopogon insularis A. Cunn. Shrub. East Wallabi* (pavement and consolidated dunes).

PRIMULACEAE

**Anagallis femina* Mill. Annual. West Wallabi*.

PLUMBAGINACEAE

Limonium salicorniaceum (F. v. M.) Low spreading shrub. North* (shallow soil over limestone), East Wallabi, (hollows in consolidated dunes) West Wallabi* (shell grit and guano banks), Tattler I., Pigeon I.

GENTIANACEAE

**Erythraea centaurium* Pers. Annual. North I.* (shallow soil over limestone), East Wallabi*, West Wallabi* (pavement).

APOCYNACEAE

Alyxia buxifolia R. Br. Shrub. East Wallabi* (shell grit, pavement, consolidated dune), West Wallabi (limestone near coast).

ASCLEPIADACEAE

Sarcostemma australe R. Br. Sprawling succulent shrub. East Wallabi* (consolidated dunes), West Wallabi and Pigeon I. (pavement).

BORRAGINACEAE

Cynoglossum australe R. Br. Annual. East Wallabi, West Wallabi*.

Trichodesma zeylanicum (L.) R. Br. Tall annual. North I.*.

VERBENACEAE

Avicennia marina (Forsk.) Vierh. Small tree (mangrove). West Wallabi* (a few in salt creek and at foot of nearby islet), Tattler I. (good clump on northern sheltered side of islet).

LABIATAE

Westringia dampieri R. Br. Shrub. East Wallabi* (pavement, consolidated dunes and, rarely, sand dunes), West Wallabi (limestone near coast).

SOLANACEAE

Solanum nigrum L. Herb. East Wallabi* (consolidated dunes and pavement, especially in and near wells), West Wallabi*.

Nicotiana rotundifolia Lindl. Annual. North I.*, East Wallabi*, Pigeon I.*.

SCROPHULARIACEAE

**Dischisma arenarium* E. Mey. Small annual. West Wallabi (shell grit).

MYOPORACEAE

Eremophila glabra (R. Br.) Ostenf. Low, somewhat flaccid shrub. East Wallabi* (consolidated dunes), West Wallabi (in a restricted area a little east of Horse Well).

Myoporum insulare R. Br. Shrub, sometimes tall. North I.* (inner slope of eastern dunes), East Wallabi*, West Wallabi (pavement and sand near coast), Pigeon I., Long I.

PLANTAGINACEAE

Plantago varia R. Br. Annual. North I.* (shallow soil over limestone), East Wallabi*. West Wallabi*.

RUBIACEAE

Galium sp. Small annual. East Wallabi*.

GOODENIACEAE

Scaevola crassifolia Labill. Shrub. North I.* (dunes), East Wallabi (sandy and consolidated dunes).

COMPOSITAE

Brachycome iberidifolia Benth. Annual. East Wallabi*.

B. ciliaris (Labill.) Less. Annual. North I.*, East Wallabi*.

Vittadinia triloba (Gaud.) DC. Annual. East Wallabi*.

Olearia axillaris (DC) F. v M. Shrub. North I.*, East Wallabi*, West Wallabi, Pigeon I.

Gnaphalium luteo-album. L. Annual. North I.* East Wallabi*.

Podosperma angustifolium Labill. Annual. North I.*, West Wallabi*.

Calocephalus aeruoides (F. v. M.) Benth. Annual. East Wallabi*, West Wallabi*.

Gnaphalodes uliginosus A. Gray. Annual. North I.*, East Wallabi*, West Wallabi*.

Senecio lautus Soland. Annual (or perennial in favourable situations). Mainly coastal. North I.*, East Wallabi*, West Wallabi, Pelican I., Pigeon I.

S. brachyglossus F. v. M. Annual. North I.*, East Wallabi*.

Picris hieracioides L. Annual. East Wallabi*.

**Sonchus oleraceus* L. Annual. North I.*, East Wallabi, West Wallabi*, Pelican I., Tattler I., Pigeon I.

Reptiles

The Wallabi Islands have a surprisingly rich reptile fauna. Of the 18 species* definitely recorded from the group, all occur on West Wallabi which has an area of only 2.3 square miles. Moreover, several species are represented by abnormally dense populations, viz. *Egernia stokesi, Amphibolurus barbatus, Phyllurus milii* and *Python spilotus*. On the other hand, certain species (notably the geckoes *Gehyra variegata* and *Heteronota bynoei*) are rare by mainland standards. Nevertheless, reptiles are clearly the dominant vertebrates in the group, and they have evidently profited from the scarcity of land birds (5 resident species).

Apart from their ecological interest, Abrolhos reptiles are important taxonomically, for the types of seven species came from these islands. Knowledge of this fauna began in 1840 with the collections of HMS Beagle, two of whose officers are commemorated in *Egernia stokesi* and *Heteronota bynoei*. Two years later John Gilbert visited the Abrolhos, but unfortunately, as with the 'Beagle' collections, no record was kept of the islands on which his numerous specimens were obtained. Gilbert (1843) does mention a lizard on Pelsart Island that is undoubtedly *Egernia kingi*. He also saw a Green Turtle in the Wallabi Group, and on most islands he found the remains of "Hawksbill Turtles."

The ornithologist A. J. Campbell visited the Abrolhos in December 1889 and recorded five species, only one of which (*Python spilotus*) explicitly came from the Wallabi Group (Campbell 1890). During a long visit in 1894-5, Otto Lipfert (a former preparator in the W.A. Museum) seems only to have collected *Rhynchoelaps bertholdi*, a single specimen from West Wallabi.

The naturalists of the Percy Sladen Trust Expedition to the Abrolhos in 1913 and 1915 were the first generally to record the precise locality of their specimens. They obtained ten species on the Wallabi Islands, eight of them constituting the first definite record for the group (Alexander 1922).

An expedition from Harvard University spent a fortnight on the Wallabi Islands in October 1931. Their large collection of reptiles included six species that were new for the group (Loveridge 1934).

During four visits in 1959-60, my colleagues and I were only able to add another two species. It would seem, then, that the fauna was almost completely known. Yet in the British Museum (according to its catalogues) there are six more species from the Abrolhos: *Diplodactylus vittatus* Gray, *Egernia whitei* Lacépède, *Tiliqua rugosa* (Gray), *Sphenomorphus richardsoni* (Gray), *Hemiergis quadrilineatus* (Gray), and *Denisonia coronata* (Schlegel), as well as two species of frog: *Limnodynastes dorsalis* (Gray) and *Myobatrachus gouldi* (Gray). The specimen of *Sphenomorphus richardsoni*, collected by Bynoe, remains unique. All the others were collected by Gilbert. Perhaps most if not all of them actually came from the mainland; though it is possible that they were collected in the imperfectly explored Pelsart and Easter Groups, from which only two species are certainly known: *Egernia kingi* (Pelsart Island) and *E. stokesi* (Rat Island). However, more field work must be carried out on the islands before these problematical species are disposed of. As none of them are localised, they are excluded from the following list.

*Recently an additional species was collected by the Aquinas College Expedition, viz. the skink, *Rhodona nigriceps* (Glauert).

GEKKONIDAE

Phyllurus milii Bory. East Wallabi, West Wallabi, Pigeon I. Abundant; especially under slabs of limestone. Commonly seen at night when out feeding on bare ground.

Diplodactylus spinigerus Gray. West Wallabi. Moderately plentiful. Several were found walking on the ground in daylight. Gilbert collected the two syntypes in the Abrolhos.

Phyllodactylus ocellatus (Gray). West Wallabi. Uncommon. The two syntypes of *Diplodactylus bilineatus* Gray (currently regarded as synonomous with *ocellatus*) were obtained by Gilbert in the Abrolhos.

Phyllodactylus marmoratus (Gray). East Wallabi, West Wallabi, Pelican I., Tattler I. Not common on the larger islands, but abundant under slabs of limestone on offshore islets, where it is the only gecko. My specimen from East Wallabi came from a hollow eucalypt log. Four of the five syntypes were collected by Gilbert in the Abrolhos.

Heteronota bynoei Gray. West Wallabi. In contrast to their abundance on the mainland of Western Australia this and the following species are the rarest geckoes in the group. The Harvard Expedition collected one, and I got two under driftwood on a shingly beach. The type was obtained by Gilbert in the Abrolhos.

Gehyra variegata (Duméril & Bibron). West Wallabi. The two I collected are the only specimens from the Abrolhos apart from one in the British Museum whose collector is unknown.

PYGOPODIDAE

Lialis burtoni Gray. East Wallabi, West Wallabi. Uncommon. This may be the 'small grey snake' seen by Alexander on East Wallabi and tentatively referred to *Denisonia coronata*.

Delma fraseri Gray. West Wallabi. Alexander's two specimens are the only record for the Abrolhos.

AGAMIDAE

Amphibolurus barbatus (Cuvier). East Wallabi, West Wallabi. Abundant, especially in sandy country among clumps of *Spinifex longifolius*. These lizards differ considerably from those on the mainland of Western Australia and were described by Loveridge as a distinct race, *minimus*. They are mainly distinguished on their smaller size, narrower head, and longer tail and hind-legs.

SCINCIDAE

Egernia stokesi (Gray). East Wallabi, West Wallabi, Tattler I., Pigeon I. Abundant, especially under slabs of limestone. Two of my East Wallabi series were taken from the hollow stems of dead shrubs. The 12 syntypes were collected in the Abrolhos, four of them by Gil-

bert, the others presumably by the 'Beagle'. Abrolhos specimens never attain the size of mainland animals.

E. kingi (Gray). East Wallabi, West Wallabi, Pigeon I. Moderately plentiful, favouring *Spinifex longifolius* and other coastal habitats. Also seen, but not captured, on Tattler Island, a ¾ acre islet off the east coast of West Wallabi. The Abrolhos population probably merits subspecific rank.

Ctenotus lesueuri (Duméril & Bibron). East Wallabi, West Wallabi. Plentiful in all habitats. The 14 specimens obtained by the Harvard Expedition were misidentified by Loveridge as *Egernia formosa* Fry, a species that is restricted to the Kalgoorlie-Laverton region.

Rhodona praepedita (Boulenger). East Wallabi, West Wallabi. Uncommon. My East Wallabi specimen was collected under leaf litter in the eucalypt thicket. Two specimens obtained a few days earlier on North Island were listed in Storr (1960) under *Lygosoma praepeditum* Boulenger, a commonly used synonym of *lineata*.

Ablepharus boutoni (Desjardin). East Wallabi, West Wallabi. My specimens came from low cliffs of limestone, into the crevices of which they dart when disturbed. They belong to the race *plagiocephalus* Cocteau. A small skink seen on Tattler Island was possibly of this species.

Ablepharus lineocellatus Duméril & Bibron. East Wallabi, West Wallabi. Moderately plentiful in sandy country. This is the species referred to by Alexander as a Lygosoma with an 'orange head and pink throat'.

Ablepharus elegans (Gray). West Wallabi. The three specimens of the Harvard Expedition are the only record for the Abroholos.

BOIDAE

Python spilotus Lacépède. East Wallabi, West Wallabi. Common in all habitats. During the day they are usually found coiled up beneath a bush, though an occasional one may be seen moving around. At night they are more active. They probably hibernate in winter; at any rate none was seen during my visit in late June 1959. One of the specimens collected by the Harvard Expedition had just swallowed a young *Egernia stokesi*. J. Akerstrom, a fisherman living on West Wallabi, has seen young wallabies inside Carpet Snakes.

ELAPIDAE

Rhynchoelaps bertholdi (Jan). East Wallabi, West Wallabi. Uncommon. Usually found under slabs of limestone.

Land Birds

In contrast to the diversity of the herpetofauna, only five species of bird are certainly resident in the Wallabi Group. Two more species, the kestrel and cuckooshrike, are possibly resident, and the cuckoo could be a regular visitor in spring.

Little has been learnt of the land birds since Gilbert's visit in 1843. Later workers have paid much more attention to the sea birds, which nest in great numbers on these islands. A paper devoted to marine and littoral species has been prepared for publication in the *Emu*.

TURNICIDAE

Turnix varia (Latham). The Painted Quail is common on East and West Wallabi. Also occurred on one of the Pigeon Islands (Alexander 1922).

Most of the West Wallabi population occurs in low dunes covered with *Spinifex* and in the more open parts of the saltbush and samphire flats. They are even found in the dense tangles of *Nitraria* covering the old guano workings north of Eagle Point; but they shun the large areas of pavement limestone. Much of their food is obtained by scratching in the surface soil, the resultant scrapes being very characteristic of the areas they are abundant in. On loose sand, e.g., just above high-water mark, the scrapes tend to be circular depressions about 5 inches in diameter and 1-2 inches deep. Further inland they are less deep and usually crescentic in shape and thus remarkably like the hoof-marks of horses. They are excavated by scratching 2-3 times with one foot, then half-rotating the body and scratching with the other foot. They also visit the fishermen's camp at Pelican Point to feed on scraps.

At night they sleep on the ground, usually in pairs side by side at the foot of a bush. Their eyes shine red in torch-light, and they can often be picked up by hand. The weight of six birds was, 61, 65, 65, 66, 67 and 70 g. The colour of the upper bill was dark bluish grey, the iris vermilion, and the legs deep chrome-yellow.

On April 26, 1960, one was flushed from a nest south-east of the 'Walls'. It was located among shrubs of *Frankenia pauciflora*, which on West Wallabi dominates the narrow zone between shelly flats and limestone ridges (this ecotone constitutes a favourite feeding area). The nest was a saucer shaped depression nearly 4 inches across and ¾ inch deep, lined with fine twigs, and sheltered from above by a *Frankenia*. The three white eggs were finely dotted with brown and had underlying grey spots. Further south (and a little inland from Rocky Bay) a nest was found that was protected from above by a sparse dead bush and a few windblown inflorescences of *Spinifex*. The three eggs were somewhat different in colour to the first clutch; they were pale brown, finely flecked with reddish and dark brown. That evening two chicks were found among *Spinifex* behind the fishermen's huts at Pelican Point. Hall (1902) found eggs on October 20, which indicates a long breeding season.

The Abrolhos populations constitute an endemic race, *scintillans* Gould. The differences between it and the mainland race, *stirlingi* Mathews, are discussed by Alexander (1922).

COLUMBIDAE

Phaps elegans (Temminck). The Brush Bronzewing is common on East and West Wallabi and Pigeon Island.

On West Wallabi they occur in all kinds of vegetation, including (unlike the quail) the scrub growing on limestone. On April 21, 1959, an empty nest was found on top of a *Spinifex* tussock. The saucer-shaped platform of *Spinifex* roots was 5 inches in diameter and sheltered from above by a few blades of the grass. On

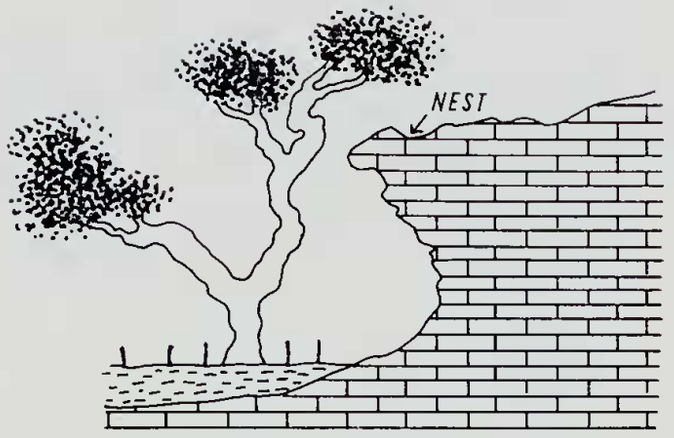

Fig. 3.—Location of Brush Bronzewing nest on Tattler Island. Height of cliff about five feet.

April 26 of the following year a pigeon was flushed from two eggs in a relatively substantial nest in a dense bush of *Myoporum insulare* near East Well. On the same day a remarkable nest was found on Tattler Island; the two eggs had been laid on a few fine twigs placed in a slight depression in the limestone at the edge of a low cliff, the nest being sheltered from above by the dense foliage of a mangrove (see sketch, Figure 3). Since Alexander found a nest with a fresh egg as late as November, the breeding season must be spread over many months.

Four birds (the first three female) shot on West Wallabi on April 22, 1959, had the following data: weight, 185, 157, 169, 173 g; wing, 155, 157, 156, 154 mm; total length in the flesh, 284, 278, 274, 280. The bill was black; the legs red, becoming black towards ends of toes; and the iris very dark brown (almost black).

A ringed Domestic Pigeon was caught at the fishermen's camp on West Wallabi in April 1958 (H. Akerstrom).

FALCONIDAE

Falco cenchroides Vigors & Horsfield. Status uncertain. Nankeen Kestrels were occasionally seen singly above the dunes along the south-west and south coasts of West Wallabi and the south-west coast of East Wallabi. They favour blown-out or sparsely vegetated sections of the dunes. In view of the great number of lizards on the Wallabi Islands, it is surprising that this species is not more plentiful.

PSITTACIDAE

Cacatua roseicapilla Vieillot. Vagrant. A small flock of Galahs flew south over the fishermen's camp on West Wallabi in June 1957 after a long period of strong E.N.E. winds (H. Akerstrom, pers. comm. 19/iv/59).

CUCULIDAE

Chalcites basalis Horsfield. Status uncertain. A Horsfield Bronze-Cuckoo was heard in the centre of West Wallabi on September 10, 1959.

HIRUNDINIDAE

Hirundo neoxena Gould. The Welcome Swallow is resident in small numbers on East and West Wallabi and Pigeon Island. On September 9, 1959, a nest with three eggs was found in a hut on West Wallabi.

CAMPEPHAGIDAE

Coracina novaehollandiae (Gmelin). Status uncertain. On April 17, 1959, a Black-faced Cuckoo-Shrike was observed on West Wallabi in limestone scrub near Horse Well. On June 23 there was one at almost the same place, and on the following day two were seen about a mile further north. On September 8 one was observed at the eucalypt thicket on East Wallabi.

MALURIDAE

Sericornis maculatus Gould. The Spotted Scrub-Wren is moderately common on East and West Wallabi. On September 9 a juvenile was seen on West Wallabi, just able to fly. At that season the singing was especially vigorous.

Mayr and Wolk (1953) recognised the subspecific distinctness of the Wallabi Islands population, for which the name *houtmanensis* Zietz has priority (by one year) over *fuscipes* Alexander (1922).

ZOSTEROPIDAE

Zosterops lateralis (Latham). The Grey-breasted Silvereye is moderately common on East and West Wallabi (including Tattler Island) and Pigeon Island. During the crayfishing season on West Wallaby they concentrated (in flocks of up to 40) at the fishermen's camp, where they fed on scraps, the most favoured item being the discarded halves of rock-melons whose remaining flesh was cleanly stripped. They were very bold and entered huts as soon as their occupants left them.

Mammals

A wallaby and a rat are the only land-mammals in the Wallabi Group. The wallaby, described by Pelsart in 1629, was probably the first Australian mammal to be observed by Europeans, whereas the rat was not discovered till nearly 300 years later. A species of seal has been included in the following list, but the Cetacea have been omitted (although two species of dolphin are common in these waters, their identity remains uncertain).

MACROPODIDAE

Macropus eugenii (Desmarest). Formerly occurring on North Island (Storr 1960), the Tammar is now confined in the Abrolhos to East and West Wallabi. The population on West Wallabi amounts to some hundreds, the animals being most numerous on the flats of shell grit, where they hide during the day in tunnels through the densest clumps of saltbush and samphire. They also occur on the limestone pavement where thickets of *Pittosporum phillyreoides* and other tall shrubs provide them with daytime shelter. The population on East Wallabi seems to be much smaller. Here the wallabies are most numerous in the low scrub round the old airstrip.

Most of the sink-holes containing water have been covered up on both islands; of the remainder it is doubtful whether any constitute a water supply for the Tammars. Certainly some animals have attempted to reach the water but, as their skeletons testify, have failed to climb out. Their principal source of water would be the juices of the plants they feed on.

Like the Quokkas on Rottnest, the Tammars prefer the more succulent species of plants, e.g. *Rhagodia baccata, Sarcostemma australe* and *Arthrocnemum halocnemoides*. The most heavily browsed of the non-succulent shrubs are such relatively soft-leaved species as *Pimelea microcephala, Eremophila glabra* and *Hibbertia subvaginata*. Most of the remaining species of shrubs are browsed at some time or other, and individuals of the following were noted as 'hedged': *Diplolaena dampieri, Spyridium globulosum, Exocarpus aphylla, Pittosporum phillyreoides, Capparis spinosa, Mirbelia ramulosa, Myoporum insulare, Westringia dampieri,* and occasionally *Grevillea argyrodendron*. The bark of *Dodonaea aptera, Lasiopetalum angustifolium, Eremophila glabra* and *Acacia bivenosa* is more sought after than the foliage. The tough leaves of the liliaceous herb *Dianella revoluta,* are evidently eaten only when young. In winter and spring the annual herbage must comprise a large part of the diet. At any rate these plants never grew so tall or dense on the main islands as on offshore islets. The most favoured species are the grasses, *Bromus arenarius, Agrostis avenacea* and *Setaria dielsii.*

So as to gain some idea of the nutritive value of the vegetation, terminal foliage was collected on each trip in 1959, brought to Perth wrapped in plastic, and weighed before and after oven-drying. Water content of the plants are set out in Table 1, including, where available, estimates for the same species on Rottnest at the same dates (the latter were interpolated from water-content graphs, plotted from data obtained over several years).

The samples of April 22 were also tested for content of crude protein. The following values (% dry weight) were kindly supplied by the Government Chemical Laboratories, and for comparison Rottnest estimates for that date are again given in brackets where available.

Nitraria schoberi	19.2	(13.5)
Capparis spinosa	18.8	
Arthrocnemum halocnemoides	13.9	(6.0)
Pimelea microcephala	11.2	
Arthrocnemum arbuscula	11.0	(9.0)
Atriplex paludosa	10.3	(9.7)
Myoporum insulare	8.3	(7.4)
Diplolaena dampieri	8.1	(5.8)
Beyeria viscosa	6.7	
Olearia axillaris	6.3	(6.7)
Sarcostemma australe	5.6	
Pittosporum phillyreoides	4.2	(5.0)
Grevillea argyrodendron	3.8	

Although practically nothing is known of the relative amount of the various plants eaten by the Tammars, some inferences on their diet can be made from the above data. The water content of the vegetation, presumably, as on Rottnest, is lowest in late summer and highest in late winter. The disparity in this respect between summer and winter diets will be even greater than is apparent from Table 1, when it is recalled that annual herbage is available in winter and spring. Generally the water content averages somewhat lower than on Rottnest. This is especially so in the succulent species, and is a consequence of the fact that the Abrolhos only receive half as much rain at Rottnest.

Table 1

Water content (% wet weight) of West Wallabi plants. Estimates for Rottnest in brackets

	April 22	June 25	Sept. 11
Arthrocnemum arbuscula	69	76	79
Arthrocnemum halocnemoides	77 (79)	— (83)	— (90)
Atriplex paludosa	56 (75)	77 (78)	79 (85)
Beyeria viscosa	38		
Capparis spinosa	75	76	78
Diplolaena dampieri	47 (56)	67 (68)	67 (68)
Grevillea argyrodendron	49	43	58
Myoporum insulare	69 (68)	79 (75)	81 (78)
Nitraria schoberi	81 (83)	84 (91)	82 (90)
Olearia axillaris	45 (41)	61 (58)	62 (53)
Pimelea microcephala	62	78	71
Pittosporum phillyreoides	59 (57)	60 (58)	60 (61)
Rhagodia baccata	— (75)	— (81)	78 (88)
Sarcostemma australe	77	88	87
Threlkeldia diffusa	69 (81)	— (91)	83 (89)

With minor exceptions, protein levels are considerably higher on West Wallabi than Rottnest, due no doubt to the abundance of nitrogen in the guano-rich soil. Probably as on Rottnest, protein levels are at their lowest in April, rising like the water content to maxima in late winter. And as for Rottnest Quokkas, the few weeks before the break of season would be most critical for the Tammars. The relatively high level of protein in the vegetation should help tide them over this period. The average excess of protein in West Wallabi plants over Rottnest plants of the same species was 27% on April 22, at a time when the protein content of the diet of Rottnest Quokkas varies locally between 6 and 9% (Storr, 1964).

The breeding season seems to be much the same as in Rottnest Quokkas, which is understandable in view of the similar distribution of rainfall. All of four females examined in late April 1959 had a naked joey in the pouch. The largest of these was 23 cm long; two of the others were almost as large, but the smallest was only 2 cm long. In the following September many young were seen at heel.

According to the fisherman on West Wallabi, the juveniles are preyed on by Carpet Snakes *(Python spilotus)* and Sea-Eagles *(Haliaeetus leucogaster)*. This predation does not seem to be sufficiently intense to affect their numbers. In the past, human predation was at times much heavier. For example, Stokes and two companions shot 76 on West Wallabi in four hours (after which he aptly named the easternmost extremity of the island Slaughter Point). His colleague Surgeon Bynoe, in a curious account of marsupial reproduction, mentions examining the uteri of "between two and three hundred" wallabies (Stokes 1846, p. 156). It is little wonder that Gilbert (1843) found the animals more abundant on East than West Wallabi two years after the visit of the 'Beagle'.

In a recent unpublished study, J. Kelsall (pers. comm.) found the Abrolhos wallabies to differ in several characters from mainland animals. The name, *houtmanni* Gould, is available for the Abrolhos race.

MURIDAE

Rattus glauerti Thomas. In November 1907, C. P. Conigrave collected a young adult male rat in the sand dunes of East Wallabi. It was later

sent to the British Museum, where Oldfield Thomas (1926) made it the type of a new species. Thomas believed it was related to *R. fuscipes* Waterhouse of the south-western mainland, as did Iredale and Troughton (1934), who regarded it as a subspecies of *fuscipes*. Tate (1951) dissociated *glauerti* from *fuscipes*, suggesting rather that it was a recent introduction of a rat of the Malayo-Polynesian *concolor-exulans* group.

In April 1959 the writer collected three adult rats on West Wallabi, one of which was a female with 10 nipples (4 pectoral, 6 abdominal). As the mammary formula in the *concolor-exulans* group is consistently 4 + 4 (Tate 1936 and 1951), the Abrolhos rat clearly does not belong there. Despite its belated discovery (compared to that of the Tammar), there is no reason for doubting that *glauerti* is truly indigenous, and that it is an insular race of one or another of the southern Australian species of rats. As the following description shows, *glauerti* is most like *R. greyi* Gray.

The external measurements of the rats (Nos. 1-3) are given in Table 2. All three had similar pelage: long soft hair with dark bluish grey bases, tipped on the back with reddish brown and below with whitish. The short hair of the hands, feet and muzzle was whitish. The tail was uniformly dark and had 13 or 14 scales per cm. The caudal hairs were black and twice as long as the scales.

The skull prepared from specimen No. 1 measured as follows: total length 36.2, zygomatic breadth 17.1, inter-orbital breadth 5.3, cranial breadth 15.8, interparietal 10.2, nasals 11.0 × 3.6, zygomatic plate 3.2, palatal foramina 6.2 × 1.7, bulla 6.8, molar crowns 5.8, m^2 2.9 × 1.8. The rostrum was broad and flat, the braincase rounded and unridged, and the bullae were rounded.

On the following June 22 another five adults were caught on West Wallabi: No. 4 (♂, weighing 79.5 g), No. 5 (♀, 99), No. 6 (♂, 105), No. 7 (♀, 82.5, and No. 8 (♂, 81). On the evening of September 8, 1959, two adults were taken in break-back traps in the sand dunes behind Turtle Bay, East Wallabi: No. 9 (♂, 82), and No. 10 (♀, 67—it had lost all but the tip of its tail). Few rats were seen on West Wallabi in September, and the only ones caught were two juvenile females early in the morning of the 12th: No. 11 (45) and No. 12 (47). On April 23-25, 1960, three adult males were caught on West Wallabi: No. 13 (not weighed), No. 14 (70) and No. 15 (81); the testes of the last two were greatly enlarged.

Specimens No. 1-12 have been lodged in the Western Australian Museum. As specimens No. 13-15 are no longer available in Western Australia, their measurements are given in Table 2 (I measured No. 13 and J. Kelsall measured No. 14 and 15). Immediately after capture, the pelage of No. 14 was described as follows: dorsal and lateral hairs greyish brown, tipped reddish brown; guard hairs blackish; hands and feet whitish; underneath white.

Most of the rats were caught in sandy country well vegetated with *Spinifex longifolius*, a few were among saltbush on the flats of shell grit, and only one was collected on pavement limestone (it was disturbed in the daytime from a heap of stones beside East Well). Though an occasional rat may be seen in the daytime, they are really active only at night. With a head-torch their red eyes can be picked up whenever they come out to feed on the bare ground between patches of vegetation. Bewildered by the light, they are easily run down and captured. They readily bite if given the opportunity. Apparently they spend the day hidden in the bases of shrubs and tussock grasses. They certainly do not burrow.

Table 2

External measurements (mm) of six Rattus glauerti *from West Wallabi*

Field Number	Sex	Head + Body	Tail	Pes	Ear
1	♂	127	120	26.5	17
2	♂	129	113	27	18
3	♀	131	123	26	18
13	♂	104	117	26	18
14	♂	134	104	26	20
15	♂	141	107	27	19.5

The rats were so numerous on both islands in 1959-60 that I cannot understand why the species was not discovered before 1907. Perhaps their numbers undergo large fluctuations and my visits happened to coincide with a population peak. With so many fishermen resident in the Wallabi Group during the crayfishing season, the future of this beautiful little rat is very insecure. A few feral cats could soon exterminate it.

OTARIIDAE

Neophoca cinerea (Péron & Lesueur). The Hair Seal was formerly abundant, even though the Abrolhos are towards the northern limit of its Western Australian range. In his account of the Wallabi Islands, Gilbert (1843) wrote, "all the islands in this group are thickly inhabited by the seal; we would frequently come upon groups of 7, 8, and 9, lying asleep on the sandy beach; they are very easily captured, by walking steadily up to them with a club, when a single blow on the nose brings them down." In 1889 Campbell observed that they were "principally found in the Easter and Pelsart groups but now getting scarce."

I saw none during my four visits, though one was missed by only three days; it followed fisherman G. Klee in his boat for a short distance past Pelican Point on April 16, 1959. In the following September I found the remains of an adult male among the mangroves off the south-east coast of West Wallabi. It had evidently been dead for a month or more. Its skull was brought back and later lodged in the Western Australian Museum.

This magnificent seal shows little fear of man, which has resulted in its decimation throughout the greater part of its range.

Discussion

In his summary of the vertebrate fauna of the Abrolhos, Alexander (1922) contrasted the wealth of the Wallabi Islands with the poverty

of the Easter and Pelsart Groups. He concluded that the land fauna of the Abrolhos had been derived from the mainland via the Wallabi Islands by transmarine dispersal. He also concluded that when the islands were populated with this fauna the opposite mainland must have been more like the extreme South-west than it is today. Neither of these hypotheses is tenable now.

Alexander was evidently unaware of the general post-Pleistocene rise in sea-level, and that islands as distant from the mainland as the Abrolhos could nevertheless be only a few millennia in age. The separation of the Wallabi Islands from the mainland was dated by Main (1961) at 11,500 years ago. While some doubt may attach to the precise date of their separation, other evidence confirms that the Wallabi Islands were formerly part of the mainland.

Although the rocks underlying them are of marine origin, the dunes of the Wallabi Islands (and North Island) could only have formed when the area was continental. Admittedly, calcareous sand is produced on islands by the weathering of limestone; production, however, is generally outpaced by removal when sea-level is rising or stationary. Even on an island as large as Rottnest, dune and beach sand is continually being lost to the sea (Storr 1963).

Moreover the fauna and flora of the Wallabi Islands are distinctly continental in their richness and balance. It is too much to suppose that two species of mammal, two snakes, 16 lizards (in 12 genera and four families) and 114 vascular plants (in 94 genera and 50 families) have crossed Geelvink Channel in sufficient numbers to become established on these small islands.

That many of these animals occur on other west coast islands is a reflection of their ability to survive on shrinking land masses rather than ability to cross the sea. A few species, e.g. *Delma fraseri, Egernia stokesi* and *Rattus glauerti* have not, to the writer's knowledge, been found on other islands. Similarly with the flora, while there are many species common to a number of west coast islands, there are some that are not otherwise insular. In the latter category are the orchid *Microtis unifolia* and the shrubs *Grevillea argyrophylla, Trichinium eriotrichum, T. divaricatum, Aphanopetalum clematideum, Bossiaea rufa, Hibbertia subvaginata* and *Sarcostemma australe*. The greater part of the fauna and flora is widespread in coastal situations, especially those with calcareous rocks and soils. But none of the animals and few of the plants seem especially adapted for transmarine dispersal.

Alexander's second hypothesis was based on the belief that certain vertebrate animals occurred considerably further north on the Abrolhos than on the west coast mainland. Alexander was not explicit as to the nature of the change on the mainland; it has been interpreted as one of "climatic deterioration" (Serventy and Whittell 1948, p.50).

In the last few years naturalists have paid increasing attention to the mainland north of Perth, and the known range of most of the species cited by Alexander has been advanced, one by one, to the latitude of the Abrolhos and even beyond. Since Alexander's time the known northern limit of the Brush Bronzewing has been extended from the Moore River successively to the Hill River (Storr and Ford 1959) and Freshwater Point, 25 miles south of Dongara (Ford 1960); the Painted Quail from the Moore River to the lower Murchison (Sedgwick and Morrison 1949) and to Peron Peninsula (Bathgate, pers. comm.); the Spotless Crake from Perth successively to Yanchep (Serventy and Whittell 1948) and Hutt Lagoon (Ford 1962); and *Egernia whitei (sensu lato)* from 30 miles north of Perth to Eneabba (on the mainland) and to Bernier Island in Shark Bay (Douglas and Ride 1962).

There only remain *Denisonia coronata, Rattus fuscipes* and *Macropus eugenii*. The known range of *Denisonia coronata* on the mainland has only been extended north from Perth to Gingin (Glauert 1957); but the supposed occurrence of this species in the Abrolhos has never been confirmed. It is also irrelevant that *Rattus fuscipes* is still known only from the south coast, for the Abrolhos rat has been shown since Alexander's time to belong to a different species *(R. glauerti)*.

The Tammar has not been collected on the mainland any further north than in Alexander's time. There is, however, some evidence that it exists on the mainland opposite the Abrolhos. In October 1962, I had a fleeting glimpse of a small macropod in *Acacia rostellifera* scrub, 12 miles north of Balline; it did not appear to be a young Grey Kangaroo, the common species in that area. A few months later, Mr. Tom Pepper, of Tamala Station, told me that a "grey wallaby" lived in York Gum and other thickets on Lynton Station (especially the Port Arthur thicket), but he had not heard of them for twenty years. Recently Dr. W. D. L. Ride (pers. comm.) examined a rough skin of a wallaby that was shot five miles inland from Port Gregory; he believes that it was almost certainly from a Tammar.

Alexander did not consider the flora of the Abrolhos. Had he done so, he might just as easily have arrived at the opposite conclusion, that the climate of Geraldton was formerly drier and warmer. Most Abrolhos plants extend well to the north and south of the islands. I know of none that has its northern limit in the islands; whereas at least two species *(Capparis spinosa* and *Sarcostemma australe)* are not known from so far south on the mainland coast.

The fate of Alexander's hypothesis is a sobering reminder that while it is fairly easy to discover what is present on an island, it is much more difficult to ascertain what is absent from the mainland.

Churchill (1960) and various members of the A.N.Z.A.A.S. Quaternary Shoreline Committee have cited evidence, from Australia and New Zealand, that 4-5000 years ago sea-level was 9-10 feet higher than now. At first sight the small islands immediately east of the Wallabi Islands fit in well with the concept of a previous 9-10 foot higher sea-level. Their flat tops, 5-8 feet above present sea-level, are consistent with submarine planing. The richness

of their fauna and flora, however, is quite inconsistent with any hypothesis that demands their submergence since they were initially severed from the main islands.

Pigeon Island, for example, is only 400 yards long and 100 wide and is separated from East Wallabi by half a mile of sea. Yet its vegetation is not noticeably less diversified than any similar area of pavement limestone on East or West Wallabi. Its flora comprises 30 species, most of which are woody plants. It is inconceivable that so many shrubs like *Capparis, Sarcostemma* and *Grevillea* could have become established on this island in 2-3000 years.

It is possible that these islands were at least 7 feet higher 4,000 years ago and that falling sea-level has kept pace with their loss of elevation. If the islands have been lowered by surface erosion, the pavement limestone on the Wallabi Islands should attain elevations of up to 15 feet where it is protected by overlying dunes. No such elevations have been observed, but then exposures are very limited in which the contact can be seen between pavement and dune limestone. At any rate surface erosion is probably a less potent force here than subterranean solution and the subsequent collapse of the caverns so produced. Alternatively the islands may have lost elevation through general subsidence of the continental shelf (in which case the age of the islands would be overestimated).

Whereas a 9-10 foot rise in sea-level would drastically reduce the area of East and West Wallabi and completely obliterate all the smaller islands, a two-foot rise would hardly effect the latter, margined as they are with vertical cliffs. It has already been conjectured that Shag Bay must formerly have penetrated deeply into the north-western part of West Wallabi. West of East Well the pavement limestone terminates abruptly in low cliffs that have every appearance of having formed under coastal conditions. Such a transgression of the sea would have required a rise in sea-level of no more than two feet.

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